THURSDAY, JANUARY 4, 1883

AUGUSTUS DE MORGAN

Memoir of Augustus de Morgan. By his Wife, Sophia Elizabeth de Morgan. With Selections from his Letters. (London: Longmans, 1882.)

"DE MORGAN is certainly no commonplace man." Whenever we read this sentence in Crabb Robinson's Diary we wonder how so acute an observer could have penned it. No one who has read the shortest article by De Morgan, or who has been in his company for however short a time, but would say that he was the very opposite of commonplace. Indeed the Diarist himself elsewhere records "De Morgan called. He is the only man whose calls, even when interruptions, are always acceptable. He has such luminous qualities, even in his small talk." This last testimony all who knew De Morgan will accept as true. Though nearly twelve years have passed away since the death of this eminent mathematician and logician, no account, so far as we know, has been given of his life and writings, save the appreciative notice by the late Prof. W. Stanley Jevons—whose writings so amply testify to the influence De Morgan's teaching exercised over him—in the present issue of the *Encyclopædia Britannica* (vol. vii. pp. 64-67, 1877), and the interesting sketch by Mr. Ranyard in the *Monthly Notices of the Royal Astronomical Society* for February 9, 1872, vol. xxxii. (erroneously cited as vol. xxii. in Jevons's article). It was, however, well known that a "life" was being drawn up by Mrs. De Morgan. This is the work now before us, in the preface to which the writer says, "my object has been to supply that part of my husband's life, the material for which would not be within the reach of another biographer."

Augustus De Morgan was born in the year 1806 (Mrs. De Morgan is not more explicit, but we learn incidentally from a letter—p. 394—that the exact date was June 27) at Madura, in the Madras Presidency.[1] His father was Lieut.-Col. De Morgan, who had held staff, and other appointments at several stations in India. Other members of his father's family also distinguished themselves in the service of the East India Company. His mother was the granddaughter of James Dodson, F.R.S., author of the *Antilogarithmic Canon* and other mathematical works,[2] a friend also and pupil of De Moivre; from her he appears to have inherited his musical talent ("his delightful flute") and his mathematical power. From his mother too we are told that De Morgan inherited his love of a city life.[3]

When Augustus was seven months old[4] the family came to England, and first settled at Worcester, but subsequently took up their residence at Barnstaple, and other towns in the West of England. After two or three journeys backwards and forwards, the father left Madras in 1816, having been ordered home ill with liver complaint, and died off St. Helena, leaving his widow with four surviving children. De Morgan gives in a half serious, half humorous way the idea "the victim" retained of his early schooling. At four years he learnt "reading and numeration" from his father. He always spoke gratefully of his father, but doubtless what he has written in his paper "On Teaching Arithmetic," had its rise in this early experience, "it is a very common notion that this subject is easy; that is, a child is called stupid who does not receive his first notions of number with facility . . . the subsequent discoveries of the little arithmetician, such as that six and four make thirteen, eight, seven, anything but ten, far from giving visions of the Lucasian or Savilian chairs, are considered tiresome, and are frequently rewarded by charges of stupidity or inattention. . . . Irritated or wearied by this failure, little manifestations of temper often take the place of the gentle tone with which the lesson commenced, by which the child, whose perception of such a change is very acute, is thoroughly cowed and discouraged, and left to believe that the fault was his own, when it really was that of his instructor."

When about nine years of age the Rev. J. L. Fenner was for a short time his teacher; from him the boy "learnt his first—fortunately not his last—notions of Latin and Greek, with some writing, summing, how to mend a pen, and the first four verses of Gray's 'Elegy,' with a wonderful emphasis upon the 'moping owl.' He thinks, too, that 'he pitied the sorrows of a poor old man'; but on this his memory is not so clear."[1] At Taunton, under the Rev. H. Barker, he was taught Latin, Greek, Euclid, Algebra, and a little Hebrew. Of his last teacher, the Rev. J. Parsons, of Redland, near Bristol, De Morgan always spoke with respect. "It was strange that among so many teachers the germ of mathematical ability should have been so long unnoticed. It could not be quite latent or quite unformed in the brain of a boy of fourteen; it can only be supposed that the routine of school teaching smothered and hid it from observation." It was whilst at Taunton that a friend, seeing the boy very busy in making a neat diagram with ruler and compasses, asked him what was to be done. He said he was *drawing mathematics.* "That's not mathematics," said his friend; "come and I will show you what is." The lines and angles were rubbed out, and the future mathematician, greatly surprised by finding that he had missed the aim of Euclid, was soon intent on the first demonstration he ever knew the meaning of. De Morgan himself writes of this time, "On referring to my own experience I find that I have always had the image of '*length without breadth.*' I remember when I first opened Euclid, at thirteen years of age, I am sure I had no bias to admit any thing which should make mathematics 'exist as a science': for I should have been better pleased if it had not existed at all, science or no science. I thought I had studies enough; and Walkingame, who I understood was a cousin of Euclid, had given me no prejudice in favour of the family. But in the first glance at the book, when I came to 'a line is length without breadth,' I felt that I had gained expression for an idea which I distinctly possessed by image, but could not have put into words. And so, in a small way, I found that geometry *did* exist as a science."[1]

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[1] De Morgan was proud of his birth in the sacred city of Madura, and at one time longed to visit his native country . . . his doing so when young was prevented by his defect of sight. From his birth both eyes were affected with the "sore eye" of India, and the left was saved (pp. 22, 5).

[2] He was also mathematical master at Christ's Hospital, and in connection with this "blot on the escutcheon," De Morgan writes that when quite a boy he asked one of his aunts "who James Dodson was," and received for answer, "we never cry stinking fish." He had to wait a few years to find out that his great-grandfather was the only one of his ancestors whose name would be held deserving of record.

[3] In the "Budget of Paradoxes" (p. 82) De Morgan applies to himself the lines:—

"Ne'er out of town; 'tis such a horrid life;
But duly sends his family and wife."

The memoir gives frequent illustrations of his dislike for even a short stay in the country (pp. 79, 94, 234).

[4] In the *Monthly Notices* "three months old" would appear to be incorrect.

[1] "Recollections by Mr. De Morgan," Appendix to Crabb Robinson's Diary, vol. iii. p. 540.

Before we leave these records of his school-days, we will cite some further remarks on the modes of instruction then in vogue—which, by his books, he more than any other writer helped to improve. When a boy arrives at school, "he is taught to *say* the table of numeration, and then proceeds through a number of rules . . . which, if he understand, it is well, but if not, nobody cares. . . . As to the reasons for the rules, the pupil cannot trouble his head (to use a common term for that much-avoided operation, thinking) about them, not knowing whether there are any at all, or whether the rules themselves came from the moon, or are a constituent part of that wisdom of our ancestors about which he sometimes hears. Should there be any natural defect in his mind, owing to which he finds it difficult to produce a correct result, knowing neither what he is to do, nor how to do it, there are several approved methods of proceeding. The best of these, unfortunately now somewhat exploded, is a flogging; which works on a principle recommended by physicians, of curing a disorder in a part which cannot be got at, by producing one in another which can. Next to this, comes the method of keeping the patient from all recreation until he has done what is required of him, it being considered the same thing in the end, whether he cannot work for want of means, or will not from want of application. It has been suggested to teach the principles involved in the rules, and thus to render the pupil their master instead of their slave; but to this plan, independently of its being an innovation, there are grave objections."[2]

At the age of sixteen years and a half he entered at Trinity College, Cambridge, and in 1825 gained a Trinity Scholarship. Devoting much of his time to music and to a rather wide range of reading (he had always "an insatiable appetite for novel-reading . . . let it be good or bad in a literary point of view, almost any work of fiction was welcome, provided it had plenty of incident and dialogue, and was not over-sentimental"[3]) he failed to attain the highest place in the Tripos, but came out Fourth Wrangler in 1827. Mrs. De Morgan notes that this failure, in a possibly fallacious test, was his own early, but unintentional, protest against competitive examinations, for which he felt excessive disapprobation even before his experience as a teacher showed him not only their mischievous effect upon mind and health, but their insufficiency to determine the real worth of a candidate for Honours (pp. 18, 56, 169). In connection with this subject we may mention that he had a great objection to marks in looking over examination papers. He said he could judge of the merits of the competitor from the whole work, but he could not reckon it up by marks, and he always refused to examine in this way.

Having conscientious scruples about the doctrines of the Established Church, he was prevented from proceeding to his M.A. degree and from sitting for a Fellowship, to which he would doubtless have been elected. "A strong repugnance to any sectarian restraints upon the freedom of opinion was one of De Morgan's characteristics throughout life." A further career at the University being thus closed against him, and having abandoned the study of medicine, he turned his thoughts to law, and entered at Lincoln's Inn. The establishment in 1828 of the London University—now University College—however gave him the opportunity of leaving the study of the Law, "which he did not like," for the teaching and pursuit of science. At the age of twenty-two, though much younger than any of the other thirty-one candidates[1] for the post, he was unanimously elected to the Chair of Mathematics. From this time, with the exception of an interval of five years,[2] he devoted himself with the greatest assiduity to the duties of the post until his final resignation in 1866.

It has been frequently remarked that De Morgan was unrivalled as a teacher of mathematics, and certainly no teaching in our University experience ever approached his in the faintest degree. Mr. Sedley Taylor writes:—

> De Morgan regularly delivered four courses of lectures, each of three hours a week, and lasting throughout the whole academical year. He thus lectured two hours every day to his College classes, besides giving a course addressed to schoolmasters in the evening, during a portion of the year . . . De Morgan was far from thinking the duties of his chair adequately performed by lecturing only. At the close of every lecture in each course he gave out a number of problems and examples illustrative of the subject which was then engaging the attention of the class. His students were expected to bring these to him worked out. He then looked them over, and returned them revised before the next lecture. Each example, if rightly done, was carefully marked with a tick, or if a mere inaccuracy occurred in the working it was crossed out, and the proper correction inserted. If, however, a mistake of *principle* was committed, the words 'show me' appeared on the exercise.[3] The student so summoned was expected to present himself on the platform at the close of the lecture, when De Morgan would carefully go over the point with him privately, and endeavour to clear up whatever difficulty he experienced. The amount of labour thus involved was very considerable, as the number of students in attendance frequently exceeded one hundred. . . . The claims which University or College examinations might be supposed to have on the studies of his pupils were never allowed to influence his programme in the slightest degree. He laboured to form sound scientific mathematicians, and, if he succeeded in this, cared little whether his pupils could reproduce more or less of their knowledge on paper in a given time . . . all *cram* he held in the most sovereign contempt. I remember, during the last week of his course which preceded an annual College examination, his abruptly addressing his class as follows: 'I notice that many of you have left off working my examples this week. I know perfectly well what you are doing; YOU ARE CRAMMING FOR THE EXAMINATION. But I will set you such a paper as shall make ALL YOUR CRAM of no use.' . . . De

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[1] "On Infinity; and on the Sign of Equality." *Camb. Phil. Soc. Trans.*, vol. xi. Part I.

[2] From a paper "On Mathematical Instruction," which, with four other papers by De Morgan, is reprinted (from the *Quarterly Journal of Education*) in the *Schoolmaster*, vol. ii., 1836. The five papers amply repay perusal even at the present date.

[3] In reference to this period of his life, he writes (1869, p. 393), "I read an enormous deal of fiction—all I could get hold of—so my amusement was not all philosophical."

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[1] In a letter to Sir J. Herschel, August 9, 1862 (p. 312), De Morgan says, "I was picked out of fifty candidates."

[2] In consequence of a disagreement with the Council he resigned his Professorship, July 24, 1831. On the death of his successor, in October, 1836, he was requested to resume his office, and did so.

[3] The exercises were placed in a case of pigeon-holes hung on the wall near the entrance to the Mathematical Theatre.

Morgan's exposition combined excellences of the most varied kinds. It was clear, vivid, and succinct—rich too with abundance of illustration always at the command of enormously wide reading and an astonishingly retentive memory. A voice of sonorous sweetness, a grand forehead, and a profile of classic beauty, intensified the impression of commanding power which an almost equally complete mastery over mathematical truth, and over the forms of language in which he so attractively arrayed it, could not fail to make upon his auditors" (pp. 99, 100).

His pupils' affection, the memoir tells us, was not gained by any laxity of discipline, for he was strict, especially as to quietness and punctuality.[1]

Such arduous labours as these would amply suffice for the generality of teachers, but the remainder of his time was occupied with other work hardly less exhausting than these. In May, 1828, he was elected a Fellow of the Astronomical Society, and in February, 1830, he took his place on the Council. In 1831 he was elected Honorary Secretary; in which position he entered with zeal, we are told, into every question brought before the Society, and his place was not a sinecure. "It is not easy to say how much of the usefulness and prosperity of the Society . . . was due to his incessant energy and effort, and to his steady judgment at difficult junctures." Though his connection with the Society lasted for some thirty years, he would never undertake the office of President. "I will vote for and tolerate no President but a practical astronomer. . . . The President must be a man of brass—a micrometer-monger, a telescope-twiddler, a star-stringer, a planet-poker, and a nebula-nabber."[2] He was frequently employed as a consulting actuary,[3] and bestowed also much time and labour upon the subject of the decimal coinage.[4]

Passing from De Morgan's public labours we hurriedly glance at him as a writer, and here we cannot do better than quote Prof. Jevons: "From the above enumeration" of his mathematical and logical writings, "it will be apparent that the extent of De Morgan's literary and scientific labours was altogether extraordinary; nor was quality sacrificed to quantity. On the contrary every publication was finished with extreme care and accuracy, and no writer can be more safely trusted in everything which he wrote. It is possible that his continual efforts to attain completeness and absolute correctness injured his literary style, which is wanting in grace; but the estimation in which his books are held is shown by the fact that they are steadily rising in market price. Apart from his conspicuous position as a logical and mathematical discoverer, we may conclude that hardly any man of science in recent times has had a more extensive, though it may often be an unfelt influence, upon the progress of exact and sound knowledge."

His love of books was intense:[1] "the most worthless book of a bygone day is a record worthy of preservation." Evidences of his minute acquaintance with all sorts of out-of-the-way works present themselves in almost all his writings, but are especially conspicuous in that wondrous repertory of wit and wisdom, the "Budget of Paradoxes." De Morgan's peculiar dislike of conventional titles, "which are not what they seem to be," led him to decline the honorary degree of LL.D. of the University of Edinburgh, and accounts for his not allowing his name to be put up for the F.R.S.[2] "Whether *I* could have been a Fellow, I do not know; as the gentleman said, when asked whether he could play the violin, 'I never tried.'" In fact, as he writes in the "Budget," he was a man who could not *groove*.

The last occurrence connected with science which gave him pleasure was the foundation of the London Mathematical Society.[3] The idea of having such a society occurred to his son George and Mr. A. C. Ranyard, and on their mentioning the matter to Prof. De Morgan, he at once gave in his adhesion to their proposition, and with the countenance thus extended by himself and other leading mathematicians who were got together in reply to a circular issued by the two founders, the Society started into existence. Prof. De Morgan was the first president, and delivered at the first public meeting (January 16, 1865) an interesting and characteristic address He continued to take a warm interest in the meetings (being a vice-president for the last time in the session 1869-70) until November 26, 1868, after which date severe illness prevented his further attendance.[4] The end came on March 18, 1871, "just after midnight he breathed his last."[5]

In the Vacation of 1837 De Morgan married Sophia Elizabeth, daughter of William Frend. This gentleman was a member of the old Mathematical, and subsequently of the Astronomical Society, had been Second Wrangler, and a Fellow of Jesus College, Cambridge. He sacrificed good prospects as a clergyman to his conscientious scruples about the doctrines of the Established Church, and was at this time Actuary of the Rock Life

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[1] A student, who joined the class in 1859, has put at our disposal some notes he wrote during the session 1859-60: "The class begins at 9 o'clock, but however early we go the Professor is sure to be there. Only once or twice have I been early enough to see him coming. He has a large head, bald at the top, and with a tremendous halo of hair round the crown. He wears a black cloth suit and a parson's white neck-cloth. His coat is a swallow-tail, and his trousers, with fob pockets, scarcely reach his boots, of which the laces are often too long. As he shuffles along he seems to be counting the flagstones or rails, urged by a sort of centrifugal force to keep the outside kerb, as Dr. Johnson used to do. In the lecture-room when the bell has rung, he always goes through the same routine at commencing. First of all he takes out a large red silk pocket handkerchief, with which he wipes his spectacles; he then readjusts them with the bridge upside down, and though he has only one eye he can see as keenly as another man with both. He then turns back the cuffs of his sleeves, and, after passing his fingers through his hair, takes his compasses in hand and looks round the room at his class. He has been talking all the time, and by this is fairly launched on his subject. . . . He often indulges in jokes with manifest gusto. The other morning he was illustrating a point, when he said, 'This reminds me of an anecdote told me once by my old Cambridge tutor, Prof. Peacock. He had been for some time striving to instil into the mind of a rather obtuse student the difference between $4x$ and x^4. At last he timidly ventured to remark, "'I think, now, Mr. A., you clearly see the difference.'" "'Yes, I think I do, but between us don't you think, Professor, it is a needless refinement?"' I think the part of his lectures I have most enjoyed has been his treatment of the Theory of Probabilities. In this he seemed to revel." Then follow remarks similar to Mr. Taylor's, and he concludes: "No Professor takes more pains with his class, and all through the session he deposits, in the Library, Tracts written by himself on the particular branch then in hand." We have similar testimony from other quarters.

[2] A list of the offices he held is given (p. 270).

[3] He was never connected with any office, but his advice was sought by professionals whenever there arose a "nodus vindice dignus."

[4] A full account of his work in this direction occupies pp. 235-255 of the *Memoir.*

[1] He loved to surround himself, as far as his means allowed, with curious and rare books. He revelled in all the mysteries of watermarks, title-pages, colophons, catch-words, and the like; yet he treated bibliography as an important science.

[2] Why he did not care to "shine in the dignity of F.R.S."—*See* "Budget of Paradoxes," p. 18.

[3] There is a new Mathematical Society, and I am, at this present writing, its first president. We are very high in the newest developments, and bid fair to take a place among the scientific establishments." Then in contrast with the old Mathematical Society, "But not a drop of liquor is seen at our meetings, except a decanter of water: all our heavy is a fermentation of symbols; and we do not draw it mild,"—"Budget of Paradoxes," p. 236.

[4] In the recent Presidential Address it was announced that a "De Morgan Memorial Medal," of the value of £10 would be awarded triennially by the Society. The first award to be made in November, 1884.

[5] *Monthly Notices*, "at one o'clock in the afternoon."

Assurance Office. The marriage was a most happy one, and surrounded by a family of seven children, of whom three at least died before their father, De Morgan sought his happiness, as we have endeavoured to show, in his home, amongst his books, and in the earnest discharge of his professorial and other duties.

The Memoir is charmingly written, and abounds in graphic details, which bring clearly before the reader the picture of a simple, manly character that was unique in its idiosyncrasy. A prominent object in its production has been to tell the story of the Professor's connection with University College, and of the events which led to his leaving it. "After the lapse of sixteen years I trust that the narrative will provoke no revival of the somewhat acrimonious controversy which ensued."

Another feature of the work is the selection from De Morgan's extensive correspondence with contemporary scientific men; these letters are full of interest, and abound in utterances characteristic of the writer. Always effective and to the point, they are often very humorous: the humour, indeed, sometimes borders upon trifling.

Instead of thinking that Mrs. De Morgan has exceeded due limits in her selection, we would have welcomed a far larger number of specimens. On p. 333 De Morgan states that he had corresponded for thirty years with Sir W. Rowan Hamilton, but no specimens of the correspondence are given. In one or two cases Mrs. De Morgan has deviated from the general rule she laid down for herself, and to this deviation we are indebted for some very interesting letters from the late Sir Frederick Pollock, which enlighten one as to what was required to be read for the Senior Wranglership at the beginning of the present century. Is it too much to hope that another volume may be issued containing a further selection from the correspondence, and also a few of the more valuable of the early papers, such as those which appeared in the *Journal of Education*, and in the *Companion to the British Almanac?* We venture to give the following extract from a letter we received under date May 15, 1869, as an ordinary specimen of his writing to one who had no special claim upon the writer:—". . . I should decidedly object to the reference made to Barrow on the last leaf. 'Dr. Barrow with an orthodox dislike to give unnecessary credit to a Moslem author has misled. . . .' When was there an orthodox dislike to Mahometans being discoverers in science? And what possible reason is there for imputing any such feeling to Barrow, a man of most unimpeachable fairness, except in this, that when he had a congregation by the ears he would hold on for three hours until they prevailed on the organist to 'blow him down.' He had lived among the Turks at Smyrna and Constantinople, and was certainly not ill-inclined to a Mahometan, as such. But this much is enough: the imputation is quite new, or nearly so, and should not appear without proof in the *obiter dictum* of an historical writer who obviously makes it a theory to explain something he has found. . . . P.S.—I think that for one orthodox man who might be supposed likely to rob a Mahometan of geometry, I could find three who would have been more likely to toss it back again with the remark that such infidel stuff was only fit for Mahound and his slaves."

A list of writings is appended. In this we notice the following slips:—"Elements of Arithmetic," the dates should be "1st edition, 1830; 3rd, 1835"; on p. 403, in (18) for "No. 3" read § 3 of (15) supra"; p. 404, in (18) dele "1," and in (6) for "Trigonometry" read "Geometry; p. 405, (5) should, of course, be "$Pdx+Qdy+Rdz$"; p. 406, in 1849, insert "Remarks" after "Supplementary"; in (1), (2), we think the dates are inaccurate; p. 407, read "Al*f*onsine."

We remark also that no account is taken of communications to the Mathematical Society. These were ten in number, not counting the Opening Address, which forms the first number of the Society's *Proceedings*. The only papers printed are "A Proof that every Function has a Root" (No. vi., a mere notelet); "Remark on paper by Mr. Woolhouse 'on General Numerical Solution'" (No. xiv.); and "On the Conic Octagram" (No. x. pp. 26-29). In this last paper occurs the characteristic note: "This presentation of the second hexagon was actually suggested to me by observing that *Bloise Pascal* has two hexagrams, and the jocose inference that there ought to be two hexagons in the theorem (given in the paper). My own names are both octagrams; but though I bow before the coincidence, I have no suggestion to acknowledge." There is a fairly full "Index of Names, &c.," but we do not grasp the principle upon which it is drawn up, as some names are inserted and others left out. We failed at first to identify "Prof. John Adams" with "Neptune" Adams. There are also the following corrections to be be made:—Read "J. Baldwin Brown," "Arthur Cayley" (both here and in the "Budget of Paradoxes" the famous mathematician is called "George"), Hanssen (for Haussen), Encke (for Hencke), Royal Society (insert the most important reference to p. 172), Sedgwick, Rev. C. Simeon (not J.), insert John Taylor, p. 122, and dele "p. 124" under Sedley Taylor. On p. 306 we presume x should be $\dot{x}$, and on p. 286, for 1866 read 1865; the present writer succeeded George De Morgan as teacher in the session 1865-66.

R. TUCKER

FISHES OF SWITZERLAND

Faune des Vertébrés de la Suisse. Par Victor Fatio, Dr. Phil. Vol. IV. Histoire naturelle des Poissons. 1re partie I. Anarthropterygiens. II. Physostomes-Cyprinidés. 8°. pp. xiv. et 786, avec 5 planches (Génève et Bale: H. Georg, 1882.)

AFTER an interval of nearly ten years Dr. Fatio has issued another volume of the series of excellent monographs, in which he gives the results of his researches into the vertebrate fauna of Switzerland. The first volume, published in the year 1869, contained the Mammals; the third (1872) the Reptiles and Batrachians; the second, which will be devoted to Ornithology, being still in course of preparation. The one now published, which is the fourth of the series, treats of a part of the Fishes, which class will be concluded in the fifth.

No one who studies this volume will be surprised at the long lapse of time which intervened between its appearance and that of the preceding. The author had not the advantage of being assisted in his work by collections already formed and available for the purpose, but had to collect the materials himself; a labour which, even in a small country like Switzerland, takes years to